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DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

PROCEDURE FOR TESTING EXPLOSIVES FOR ACCEPTABILITY FOR USE IN FOREST SERVICE WORK

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DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

PROCEDURE FOR TESTING EXPLOSIVES FOR ACCEPTABILITY FOR USE IN FOREST SERVICE WORK [1]

The fundamental tests to determine the acceptability of an explosive, and subsequent tests to determine the conformity of a lot of an explosive with its representative basic sample in accordance with the requirements of this circular shall, except for easily performed field tests, be made by the U.S. Bureau of Mines.

DEFINITION OF AN ACCEPTABLE EXPLOSIVE

An acceptable explosive is a detonating explosive that has been authenticated by the U.S. Bureau of Mines as being suitable, safe, and efficient for the performance of Forest Service work when used in accordance with the requirements of this circular.

Explosive mixtures of oxidants and combustibles of the gunpowder type, explosives to be compounded at the place of use, compressed and liquefied gases, and liquid explosives are not acceptable for Forest Service use.

ACCEPTABILITY TESTS

An explosive may be tested to determine (1) its basic data for admission to and its position upon the acceptable list, and (2) (when the Forest Service exercises its right to have explosives to be furnished on bids tested by the Bureau of Mines) its conformity to the type, class, and grade (with its attendant characteristics), to which the basic sample was assigned. The methods of determining this conformity of an explosive are described herein.

The items constituting the complete acceptability test which determines the admission of an explosive to the acceptable list of explosives for Forest Service work are listed under fees, which are as follows:

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U.S. Bureau of Mines Information Circular No. 6841."

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List of Fees[2]

For complete tests for:

1. Fire weather acceptable explosives	$78.00
2. Acceptable explosives that are not required to pass the fire-setting test	74.00

The items under (1) are as follows:

(a) Chemical analysis	25.00
(b) Physical examination (including cartridge count)	1.00
(c) Three test shots in the ballistic pendulum to determine the unit deflective charge	20.00
(d) Three rate-of-detonation tests, in paper tubes	5.00
(e) Water-resistance test, without wrapper	5.00
(f) Explosion-by-influence test (halved cartridge method)	4.00
(g) Pendulum friction test, to determine sensitiveness to frictional impact	7.00
(h) Freezing test, by crusher board	7.00
(i) Fire-setting capacity	4.00

Other tests:

(j) One gage test, to determine the gaseous products of explosion	15.00
(k) Lead-plate test of detonators or electric detonators	4.00

To be admitted to the Forest Service list of acceptable explosives that are not required to pass the fire-setting test (listed as 2 above) an explosive must be able not only to pass items (g) and (h), but it must continue to possess the characteristics shown in items (a) to (f), inclusive, with tolerances. The same is required for the list of fire weather acceptable explosives (listed as 1 above), and in addition the explosive must be able to pass item (i).

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[2] These fees conform to those promulgated in Bureau of Mines Schedule 1-B, Procedure for Testing Explosives Used in Metal Mines, Tunnels, Quarries and Other Engineering Operations, with Test Requirements and Schedule of Fees, 1926, 3 pp.

ACCEPTABLE EXPLOSIVES NOT TO BE CONSIDERED AS PERMANENTLY ACCEPTABLE

After further experiments and conferences the Forest Service may find it advisable to adopt additional and more severe tests to which all acceptable explosives may be subjected in the hope that, through the use of only such explosives as pass the more severe tests, the lives of blasters may be safeguarded better and the menace of fire eliminated.

The manufacturer of an acceptable explosive may withdraw it from the list, and he is urged to do so when replacing an acceptable explosive with one of superior qualities.

CONDITIONS UNDER WHICH TESTS WILL BE MADE

(1) Tests will be made at the Explosives Testing Station of the Bureau of Mines, at Bruceton, Pa., and the conduct of the tests shall be entirely in the hands of the Bureau's representative in charge of the tests.

(2) Applications for tests must be addressed to the Forester, U.S. Forest Service, Washington, D.C., in accordance with the instructions of that Bureau. The formulas of explosives for which tests are desired must accompany the applications for tests.

(3) The manufacturer or applicant granted permission to have tests made shall ship prepaid and consign to the Explosives Engineer, Bureau of Mines Testing Station, Bruceton, Pa., each explosive in cartridge sizes and quantities as requested, together with the original bill of lading, and all copies thereof. For the complete official test 50 pounds of each explosive is required. Cartridged explosives should be 1-1/4 by 8 inches in size. To facilitate the making of tests on free-flowing bag powders samples of these should also be submitted in 1-1/4-by 8-inch cartridges.

(4) If in the course of making the complete acceptability test an explosive fails on any item of the test that it should pass, or an unfavorable characteristic develops, the test shall be discontinued at that point; in such a case, or if the explosive is withdrawn, charges will be assessed for all the items of the test that have been made up to the time of the failure or withdrawal, plus a handling charge of five dollars ($5.00). The balance will be returned to the applicant.

(5) The results of tests are to be considered confidential within the applicant's organization and are not to be made public prior to official publication by the Forest Service.

PRESCRIBED CONDITIONS FOR USE OF ACCEPTABLE EXPLOSIVES

1. That the explosive is in all respects similar to the basic sample authorized for the acceptable list.

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2. That the explosive shall be stored under such conditions as to avoid changes in its characteristics as much as possible.

3. That the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.

4. That, in blasting with the explosive, electric detonators are used of not less efficiency than a No. 6, containing a charge of 1-gram of a mixture by weight of 80 parts of mercury fulminate and 20 parts of potassium chlorate.

5. That the charge shall not be fired by fuse.

6. That the charge shall not be fired without stemming or with combustible stemming, but shall be firmly confined with fireclay or other incombustible stemming.

7. That when cartridged explosives are used in blasting the "wrapper" of the cartridge shall always be included as part of the charge.

TEST REQUIREMENTS OF EXPLOSIVES FOR FOREST SERVICE WORK

Each charge shall be fired with an electric detonator of not less efficiency than a No. 6 detonator, whose detonating charge consists, by weight, of 80 parts of mercury fulminate and 20 parts of potassium chlorate (or their equivalent).

The failure of two or more charges to detonate or explode completely in the course of the official tests when fired with a suitable detonator under confinement equal to or greater than 1 atmosphere will be considered an unfavorable result.

The explosive must be in such condition that the chemical and physical tests do not show any unfavorable results. An explosive will be considered unsatisfactory if it is not chemically stable, if it shows leakage of liquid explosive ingredient, or if it is in such condition that exudation of liquid explosive ingredient would occur in handling, transportation, and storage.

REVIEW OF TEST DATA AND ASSIGNMENT OF AN EXPLOSIVE TO ITS TYPE, CLASS, GRADE, AND USE

After a sample of an explosive has been tested the data obtained will be reviewed to establish the type, class, and grade of the explosive, or, in the case of a re-test, its conformity with the basic sample. The explosives which have already been authenticated by the Forest Service are of the nitric ester or nitrosubstitution types, or mixtures which behave as such. If necessary, additional types will be established from the chemical analyses of the samples tested and chiefly on the basis of the ingredient used for sensitizing the explosive.

In establishing the conformity of an explosive after re-test to the type, class, and grade to which the basic sample was assigned the tolerances promulgated by the Bureau of Mines (for permissible explosives) will be applied to its chemical constituents other than moisture. These tolerances provide for reasonable limits of variations in the results of analyses and tests as they are repeated upon samples of acceptable explosives.

The ingredients of an acceptable explosive shall be considered to be those substances recorded as found by the Bureau of Mines in the original sample.

The basic sample will not be considered acceptable if it contains over 2 percent of moisture. A tolerance of 1.5 percent will be applied on a retested sample.

Table I contains the numerical values that will be applied for various quantities of a constituent (other than moisture) found in a retested sample.

TABLE I.-- Tolerances for other ingredients or their equivalents in quantities not exceeding 60 percent 1/

Quantity of constituent		Limit of variation of total explosive	Quantity of constituent		Limit of variation of total explosive
From -	To -		From -	To -	
Percent	Percent	Percent	Percent	Percent	Percent
0.0	1.4	1.0	23.5	26.4	2.0
1.5	2.4	1.1	26.5	30.4	2.1
			30.5	33.4	2.2
2.5	5.4	1.2	33.5	37.4	2.3
			37.5	40.4	2.4
5.5	6.4	1.3	40.5	44.4	2.5
6.5	9.4	1.4	44.5	47.4	2.6
9.5	11.4	1.5	47.5	51.4	2.7
11.5	14.4	1.6	50.5	54.4	2.8
14.5	17.4	1.7	54.5	57.4	2.9
17.5	20.4	1.8	57.5	60.0	3.0
20.5	23.4	1.9			

1/ Except for (a), all ingredients exceeding 60 percent and (b), carbonaceous combustible material regardless of quantity, the tolerance for (a) and (b) shall be equal to 3 percent. (c) Ammonium nitrate, ammonium chloride, and ammonium sulphate; the tolerance will be applied to the sum of these ingredients which will be reported as commercial ammonium nitrate. The sum of the ammonium chloride and the ammonium sulphate will be reported separately in a note, and the tolerance applied to their sum will be 4 percent of the commercial ammonium nitrate reported as present in the basic sample, except in those cases where the tolerance thus applied would be less than for a separate ingredient for, in this last mentioned case, the tolerance for "other ingredients" would apply.

Cartridge Count

The cartridge count (that is, the number of cartridges in a 50-pound case) will be computed from the physical examination and/or by actual count of the cartridges in a 50-pound case. A total variation of 10 cartridges will be allowed for cartridge counts below 130, and for 130 or over a total variation of 9 percent will be applied. As far as possible, the established variations in cartridge count will be in accordance with the variations now used commonly by the manufacturers, which are as follows:

	Cartridge count per 50-pound case
Gelatinized explosives	85-95 88-98 93-103 95-105
Ungelatinized explosives	105-115 107-117
Ungelatinized explosives, low-density	124-136 145-159 164-180

Grade

The grade of basic sample will be established on the basis of the unit deflective charge determination in accordance with table II.

TABLE II.-- Grade and unit deflective charge of acceptable explosives

	Unit deflective charge		
		Gelatinized	
Grade	Ungelatinized	Ammonia	Straight
20	260-285	-	
30	245-265	270-290	
40	225-250	255-270	245-275
50	205-225 1/		
60	205-230	225-250	210-235

1/ Straight nitroglycerin dynamite.

As an example of the use of the above table, suppose that the unit deflective charge determined on a basic sample of an ungelatinized explosive were 229; then the grade would be 40 percent.

Use

The physical characteristics found for a basic sample of explosive will be compared with those recorded in Forest Service table III 3/ and will then be recommended for use along with other explosives having similar characteristics.

BASIC SAMPLE

The term basic sample as used in this circular refers to the explosive possessing the type, class, and grade characteristics sought, as recorded in Forest Service table III, and the composition by chemical analysis recorded in the files of the Bureau of Mines. The number of basic samples may increase as new explosives are admitted to the acceptable list.

3/ Characteristics of Acceptable Explosives for Forest Service Use: Filed in Washington Office of the U.S. Forest Service.